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# Response of coriander (*Coriandrum sativum* L.) To different levels of potassium and sulphur

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**Abstract**
A field experiment was conducted on clayey soil having medium status of available N, P, K and S at Junagadh during *rabi* season of 2014-15 to study the "Response of coriander (*Coriandrum sativum* L.) to diffrents levels of potassium and sulphur. The experiment comprising of 12 treatment combinations with four levels of potassium (0, 20, 40 and 60 kg/ha) and three levels of sulphur (0, 20 and 40 kg/ha) was laid out in Factorial Randomized Block Design with three replications. Among the levels of potassium @ 40 kg/ha promoted growth parameters *viz.,* plant height, plant spread, number of branches per plant and yield attributes *viz.,* number of umbels per plant, number of seeds per umbellate, seed weight per plant, test weight, seed yield (1488 kg/ha), stover yield (1603 kg/ha) over the control. Among the levels of sulphur @ 40 kg/ha enhanced growth parameters *viz.,* plant height, plant spread, number of branches per plant and yield attributes *viz.,* number of umbels per plant, number of umbellates per umbel, number of seeds per umbellate, seed weight per plant, test weight, seed yield (1534 kg/ha), stover yield (1653 kg/ha). It also significantly increased content and uptake of NPKS kg/ha.

**Keywords:** Potassium, Sulphur, Growth attributes, Yield attributes, Yield, Nutrients content and uptake

## Introduction
India is the world's largest producers, consumers and exporter of seed spices. There are about 20 seed spices grown in India and among them cumin, fennel, coriander, fenugreek, dill seed, ajwain *etc.* are vital *rabi* seed spices for arid and semi arid regions of the country. Gujarat and Rajasthan together contribute more than 80 per cent of the total seed spices production in the country and thus, both the states together are known as "seed spices bowl" of India. Coriander (*Coriandrum sativum* L.) is one of the most important spice crop belongs to *Apiaceae* family. It is commonly known as "Dhania" or "Dhana". It is an important spice crop having a prime position in flavouring food. It is used as medicine, oil and perfumery purpose. It is the first spice to be used by man as a common flavouring substance. It is one of the earliest spices and used by mankind Luaza *et al.* (1996) [4]. It is an annual herb; coriander plant gives two primary products that are used for flavouring purposes: - the fresh green herb and the spice.
Among the primary nutrients, potassium (K) is the second most important nutrient element next to nitrogen for growth and development of spice crops (Sadanandan, 1998) [10]. Potassium is known to play a vital role in photosynthesis and carbohydrate formation in spices. It has also been shown that K plays a key role in the activation of more than 60 enzyme systems in plants. Potassium is necessary in young growing tissues for cell elongation and possibly for cell division. Potassium is very mobile in plants and therefore circulates freely and has vital role in maintenance of turgor pressure. It also helps in several physiological processes and uptake of other nutrient elements. It improves quality and yield of spices (Sadanandan, 1993) [11].
Sulphur is a secondary plant nutrient but now considered as the fourth major plant nutrient after nitrogen, phosphorus and potash. It is essential for synthesis of several vitamins and amino acids i.e., cystine, cysteine and methionine and it helps in photosynthesis and nitrogen fixation (Patel *et al.* 2013) [8]. Sulphur plays an important role in the formation of chlorophyll and improves the activity of ATP –sulphurylase enzyme. Sulphur is involved in the sulphyhydryl linkages which provide the source of pungency in oil.
One of the critical factors for low productivity of coriander in Saurashtra is due to injudicious use of plant nutrients. In this context nutrient management holds great promise in meeting the growing nutrient demand for intensive agriculture and to improve soil health and coriander productivity at a fairly high level. At present day, lack of research on response of K and S in coriander especially in Saurashtra region.

So, to decide as well as to evaluate the potential productivity of coriander in Saurashtra region through response of K and S approach is the need of research and eventually for the benefit to farmers.

## Materials and Methods

The field experiment was conducted at Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh during *rabi* 2014-2015. The soil of experimental field was clayey soil having medium status of available N, P, K and S. The experiment comprising of 12 treatment combinations with four levels of potassium (0, 20, 40 and 60 kg/ha) and three levels of sulphur (0, 20 and 40 kg/ha) was laid out in Factorial Randomized Block Design with three replications. Coriander variety Gujarat Coriander-2 was sown at 30 cm row spacing. 20 kg N/ha and 10 kg $P_2O_5$/ha was applied uniformly to all the plots at sowing. Entire dose of potassium and sulphur as per treatments was applied at sowing. Nitrogen, phosphorus, potassium and sulphur were applied in the form of Urea, DAP, MOP and Cosavet, respectively. These all nutrients were applied as a basal dose. All the recommended cultural and plant protection measures were followed throughout the experimentation. Economic analysis of different treatments was done based on the prevailing cost of input/operations and price of produce for drawing conclusion. The data were subjected to statistical analysis by adopting appropriate analysis of variance as described by Cochran and Cox (1967) [2]. In order to establish interrelationship between various components, coefficients of correlation and regression equations were computed as described by Panse and Sukhatme (1985) [7]. Summary tables for treatment effect have been prepared and furnished with standard error of mean and critical difference (CD) at 5 per cent level of probability have also been given where the treatment differences were significant. Coefficient of variance (C.V. %) was calculated and presented in the respective tables.

## Results and Discussion

### Effect of potassium and sulphur on yield, nutrient content and uptake by seed and stover

### Effect of potassium

The treatment 40 kg $K_2O$/ha recorded seed and stover yield of 1489 kg/ha and 1603 kg/ha which remain at par with 20 and 60 kg $K_2O$/ha. Crop fertilized with the 0 kg $K_2O$/ha recorded significantly the lowest seed and stover yield of 1320 kg/ha and 1411 kg/ha, respectively. Potassium is very mobile in plants and therefore circulates freely and has vital role in maintenance of turgor pressure. It also helps in several physiological processes and uptake of other nutrient elements and improves quality and yield of spices (Sadanandan, 1993) [10]. These results are in close conformity with the finding of Bhoya (2008) [1], Munnu Singh (2011) [6], Moniruzzaman *et al.* (2014) [5] and Yousuf *et al.* (2014) [14].

Despite non-significant effect of potassium levels on content of N, P and S in seed and stover, while effect of potassium levels on content of K content in seed and stover found significant (Table 3).The uptake of N, P, K and S by seed and stover (Table 4) significantly influenced by different levels of potassium. Significantly higher value of these parameters were recorded with 40 kg $K_2O$/ha ($K_3$) and 60 kg $K_2O$/ha ($K_4$) as compared control.

The enhanced uptake of N and P with potash application is ascribed to higher seed and stover yield. The increase in potassium uptake by seed and stover of coriander due to its application is mainly attributed to its medium availability in the soil (Table 2). Moreover, its application under deficient condition also increased its availability to the plants and thereby its favourable effects in life process of plants. The findings are in accordance with those of Tripathi (2006) [13], Tripathi *et al.* (2009) [12] in coriander.

### Effect of sulphur

Application of sulphur levels significantly influenced seed and stover yield (Table 1). Application of 40 kg S/ha (1534 kg/ha) being statistically at par with that of 20 kg S/ha (1499 kg/ha) in seed yield and significantly the highest stover yield (1653 kg/ha) was found under application of 40 kg S/ha. Minimum seed and stover yield observed under without sulphur application.These results of the investigation are in close conformity with Bhoya (2008) [1], Patel *et al.* (2013) [8], Lal *et al.* (2014) [4] and Moniruzzaman *et al.* (2014) [5]. The harvest index was not remarkably influenced by increasing levels of sulphur. Non-significant effect of sulphur levels on content of N, P and K in seed and stover, while effect of sulphur levels on content of S content in seed and stover found significant (Table 3).The uptake of N, P, K and S by seed and stover (Table 4) significantly influenced by different levels of sulphur. Significant the higher value of these parameters were recorded with 40 kg S/ha ($S_3$) followed by 20 kg S/ha ($S_2$) as compared to treatment to without sulphur application (0 kg S/ha).

Sulphur uptake significantly increased with increase in the levels of applied sulphur from 0 to 40 kg/ha. The increase in total uptake of nitrogen by the crop due to increases levels of sulphur could be attributed to favourable effect of sulphur application on growth and yield attributes which resulted to higher seed and stover yield. Sulphur might have shown the synergistic effect in increasing the P uptake. The findings are in close agreement with those obtained by Bhoya (2008) [1], Patel (2010) [9] and Patel *et al.* (2013) [10].

**Table 1:** Effect of various levels of potash and sulphur on seed yield, stover yield and harvest index

| Treatments | Yield (kg/ha) | | HI (%) |
|---|---|---|---|
| | Seed | Stover | |
| **Levels of Potash (K)** | | | |
| $K_1$= 0 kg $K_2O$/ha | 1320 | 1411 | 48.46 |
| $K_2$= 20 kg $K_2O$/ha | 1455 | 1554 | 48.33 |
| $K_3$= 40 kg $K_2O$/ha | 1489 | 1603 | 48.10 |
| $K_4$= 60 kg $K_2O$/ha | 1478 | 1597 | 48.05 |
| S.Em.± | 28.98 | 39.59 | 0.60 |
| C.D. at 5 % | 84.98 | 116.1 | NS |
| **Levels of Sulphur (S)** | | | |
| $S_1$= 0 kg S/ha | 1272 | 1421 | 47.34 |
| $S_2$= 20 kg S/ha | 1499 | 1550 | 49.23 |
| $S_3$= 40 kg S/ha | 1534 | 1653 | 48.13 |
| S.Em± | 25.09 | 34.28 | 0.52 |
| C.D. at 5 % | 73.60 | 100.5 | NS |
| **Interaction (K x S)** | | | |
| S.Em.± | 50.19 | 68.57 | 1.04 |
| C.D. at 5 % | NS | NS | NS |
| C.V. % | 6.06 | 7.70 | 3.75 |

**Table 2:** Effect of various levels of potash and sulphur on nutrient status of soil after harvest.

| Treatments | Available nutrients (kg/ha) | | | |
|---|---|---|---|---|
| | N | $P_2O_5$ | $K_2O$ | S |
| **Levels of Potash (K)** | | | | |
| $K_1$= 0 kg $K_2O$/ha | 215.90 | 44.61 | 193.19 | 18.11 |
| $K_2$= 20 kg $K_2O$/ha | 219.48 | 46.61 | 200.80 | 18.68 |
| $K_3$= 40 kg $K_2O$/ha | 229.43 | 46.15 | 207.42 | 18.78 |
| $K_4$= 60 kg $K_2O$/ha | 227.11 | 45.92 | 215.67 | 18.79 |
| S.Em.± | 3.65 | 0.70 | 3.37 | 0.28 |
| C.D. at 5 % | NS | NS | 9.88 | NS |
| **Levels of Sulphur (S)** | | | | |
| $S_1$= 0 kg S/ha | 218.95 | 44.89 | 198.81 | 16.92 |
| $S_2$= 20 kg S/ha | 224.41 | 46.37 | 206.61 | 19.01 |
| $S_3$= 40 kg S/ha | 225.58 | 46.21 | 207.39 | 19.84 |
| S.Em± | 3.16 | 0.61 | 2.92 | 0.24 |
| C.D. at 5 % | NS | NS | NS | 0.70 |
| **Interaction (K x S)** | | | | |
| S.Em.± | 6.32 | 1.22 | 5.83 | 0.48 |
| C.D. at 5 % | NS | NS | NS | NS |
| C.V. % | 4.91 | 4.60 | 4.95 | 4.48 |
| Initial | 282.24 | 53.86 | 211.008 | 17.02 |

**Table 3:** Effect of various levels of potash and sulphur on nutrient content by seed and stover

| Treatments | Nitrogen content (%) | | Phosphorus content (%) | | Potash content (%) | | Sulphur content (%) | |
|---|---|---|---|---|---|---|---|---|
| | Seed | Seed | Seed | Stover | Seed | Stover | Seed | Stover |
| **Levels of Potash (K)** | | | | | | | | |
| $K_1$= 0 kg $K_2O$/ha | 2.64 | 1.19 | 0.280 | 0.239 | 1.16 | 1.85 | 0.115 | 0.175 |
| $K_2$= 20 kg $K_2O$/ha | 2.80 | 1.20 | 0.286 | 0.251 | 1.25 | 1.97 | 0.122 | 0.183 |
| $K_3$= 40 kg $K_2O$/ha | 2.80 | 1.22 | 0.287 | 0.251 | 1.27 | 1.98 | 0.119 | 0.185 |
| $K_4$= 60 kg $K_2O$/ha | 2.79 | 1.23 | 0.289 | 0.256 | 1.26 | 1.96 | 0.119 | 0.182 |
| S.Em.± | 0.05 | 0.02 | 0.004 | 0.005 | 0.02 | 0.03 | 0.002 | 0.003 |
| C.D. at 5 % | NS | NS | NS | NS | 0.06 | 0.08 | NS | NS |
| **Levels of Sulphur (S)** | | | | | | | | |
| $S_1$= 0 kg S/ha | 2.68 | 1.19 | 0.285 | 0.242 | 1.22 | 1.90 | 0.113 | 0.177 |
| $S_2$= 20 kg S/ha | 2.75 | 1.22 | 0.286 | 0.250 | 1.23 | 1.94 | 0.121 | 0.186 |
| $S_3$= 40 kg S/ha | 2.84 | 1.22 | 0.286 | 0.257 | 1.25 | 1.98 | 0.122 | 0.181 |
| S.Em.± | 0.04 | 0.02 | 0.004 | 0.004 | 0.02 | 0.02 | 0.001 | 0.003 |
| C.D. at 5 % | NS | NS | NS | NS | NS | NS | 0.004 | 0.008 |
| **Interaction (K x S)** | | | | | | | | |
| S.Em.± | 0.09 | 0.03 | 0.008 | 0.008 | 0.03 | 0.04 | 0.003 | 0.005 |
| C.D. at 5 % | NS | NS | NS | NS | NS | NS | NS | NS |
| C.V. % | 5.36 | 4.90 | 4.592 | 5.770 | 4.83 | 4.01 | 4.061 | 4.931 |

**Table 4:** Effect of various levels of potash and sulphur on nutrient uptake by seed and stover

| Treatments | Nitrogen uptake (kg/ha) | | | Phosphorus uptake (kg/ha) | | | Potash uptake (kg/ha) | | | Sulphur uptake (kg/ha) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Seed | Stover | Total | Seed | Stover | Total | Seed | Stover | Total | Seed | Stover | Total |
| **Levels of Potash (K)** | | | | | | | | | | | | |
| $K_1$= 0 kg $K_2O$/ha | 34.90 | 16.78 | 51.67 | 3.70 | 3.40 | 7.09 | 15.30 | 26.18 | 41.48 | 1.52 | 2.46 | 3.98 |
| $K_2$= 20 kg $K_2O$/ha | 40.90 | 18.72 | 59.62 | 4.17 | 3.91 | 8.08 | 18.20 | 30.57 | 48.76 | 1.78 | 2.85 | 4.63 |
| $K_3$= 40 kg $K_2O$/ha | 41.54 | 19.52 | 61.06 | 4.27 | 4.02 | 8.30 | 18.86 | 31.80 | 50.66 | 1.78 | 2.96 | 4.74 |
| $K_4$= 60 kg $K_2O$/ha | 41.41 | 19.61 | 61.02 | 4.27 | 4.08 | 8.36 | 18.63 | 31.40 | 50.03 | 1.76 | 2.92 | 4.68 |
| S.Em.± | 1.19 | 0.58 | 1.54 | 0.10 | 0.11 | 0.16 | 0.37 | 0.82 | 0.97 | 0.05 | 0.07 | 0.10 |
| C.D. at 5 % | 3.48 | 1.71 | 4.51 | 0.30 | 0.34 | 0.47 | 1.09 | 2.41 | 2.84 | 0.13 | 0.22 | 0.29 |
| **Levels of Sulphur (S)** | | | | | | | | | | | | |
| $S_1$= 0 kg S/ha | 34.17 | 16.96 | 51.14 | 3.63 | 3.45 | 7.07 | 15.56 | 27.07 | 42.63 | 1.44 | 2.51 | 3.95 |
| $S_2$= 20 kg S/ha | 41.33 | 18.84 | 60.16 | 4.28 | 3.87 | 8.16 | 18.49 | 30.18 | 48.67 | 1.81 | 2.89 | 4.70 |
| $S_3$= 40 kg S/ha | 43.57 | 20.16 | 63.73 | 4.40 | 4.24 | 8.64 | 19.19 | 32.71 | 51.89 | 1.88 | 2.99 | 4.87 |
| S.Em.± | 1.03 | 0.50 | 1.33 | 0.09 | 0.10 | 0.14 | 0.32 | 0.71 | 0.84 | 0.04 | 0.06 | 0.09 |
| C.D. at 5 % | 3.01 | 1.48 | 3.90 | 0.26 | 0.29 | 0.41 | 0.94 | 2.08 | 2.46 | 0.12 | 0.19 | 0.25 |
| **Interaction (K x S)** | | | | | | | | | | | | |
| S.Em.± | 2.05 | 1.01 | 2.66 | 0.17 | 0.20 | 0.28 | 0.64 | 1.42 | 1.67 | 0.08 | 0.13 | 0.17 |
| C.D. at 5 % | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| C.V. % | 8.96 | 9.36 | 7.90 | 7.36 | 8.95 | 6.09 | 6.28 | 8.21 | 6.08 | 7.98 | 8.02 | 6.55 |

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